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ABB to advance methane detection technology for future Mars missions

- Under a new Canadian Space Agency (CSA) contract, ABB will further develop a highly sensitive spectrometer designed to quantify specific trace gases on Mars
- The instrument will be developed to monitor methane directly on the Martian surface to help investigate its source
- Although methane has been detected on Mars, its presence remains puzzling to scientists

ABB has been awarded a contract by the Canadian Space Agency (CSA) to further develop a compact, highly sensitive gas spectrometer designed to detect and quantify near-surface trace gases, such as methane, on Mars. The project is part of the Martian Atmospheric Gas Evolution Experiment (MAGE) under the agency's Space Technology Development Program.

Building on previous CSA-funded work, ABB will refine and test a Mars-tuned version of its Off-Axis Integrated Cavity Output Spectroscopy (OA-ICOS™), laser spectroscopy technology used on Earth to detect and track methane leaks. The primary objective is to enable highly sensitive detection of methane while maturing the instrument architecture compatible with future measurements of oxygen, hydrogen chloride, and water vapor on Mars. Engineers and scientists will work to reduce the measurement noise and maximize sensitivity under conditions representative of the Martian surface and atmospheric gas mixture. The work will include developing and testing a functional prototype.

Although traces of methane have been detected near the surface of Mars, its presence remains puzzling to scientists. Because methane naturally decays over time when exposed to sunlight, its continued presence in the Martian atmosphere suggests that an active source could be replenishing it.

The new technology could fundamentally change how scientists study methane on Mars. Previous investigations have been limited to remote observations from orbit or highly localized measurements at individual sampling sites. By continuously monitoring atmospheric trace gases at the Martian surface with high sensitivity, the instrument would effectively expand the searchable area, potentially revealing methane activity that has remained undetectable using existing techniques.

With the methane molecule present in extremely low concentration (about 1 part per billion) and the atmospheric pressure much lower than Earth's, ultra-sensitive technology is needed to yield meaningful

measurements. The mandate also requires monitoring on an hourly basis to track temporal fluctuations to help narrow down the possible source.

“What makes this technology exciting is that it allows us to search for trace gases in a completely different way,” said Frederic Pelletier, Business Development Manager for Space & Defense at ABB’s Measurement & Analytics division, Canada. “Rather than examining a small sample collected from a single location, we can monitor gases originating from a much larger area. If successful, this capability could help us identify the processes responsible for methane’s presence on Mars, one possibility being that methane is generated by microbes buried underground in the same way shale gas is trapped on Earth.”

MAGE is a mission concept developed in collaboration with the Lassonde School of Engineering at York University in Toronto, under the scientific leadership of Dr. John Moores and his team. The project builds on field campaigns conducted on Axel Heiberg Island, Nunavut, Canada, a terrestrial analogue site for Mars, where scientists demonstrated methane detection and spatial variability analysis relevant to future Martian methane investigations.

In Earth applications, ABB’s laser-based gas leak detection technology has sensitivity over 1,000 times higher than conventional technologies and is 10 times faster than traditional equipment in detecting single parts per billion methane and ethane. The OA-ICOS technology uses a sensitive infrared laser and highly reflective mirrors to bounce light through gas sample cells, allowing for precise measurement of very low gas concentrations.

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